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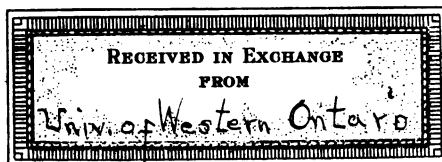
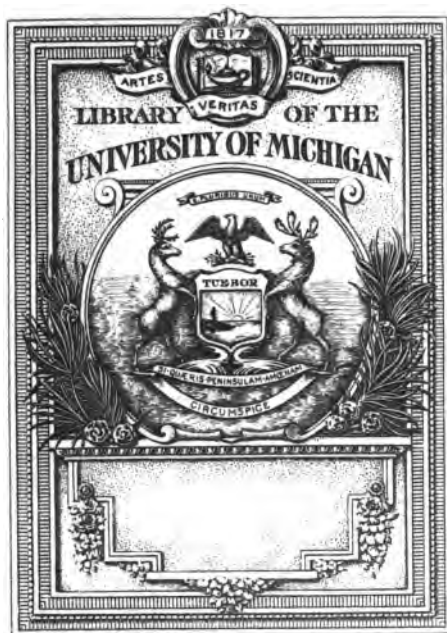
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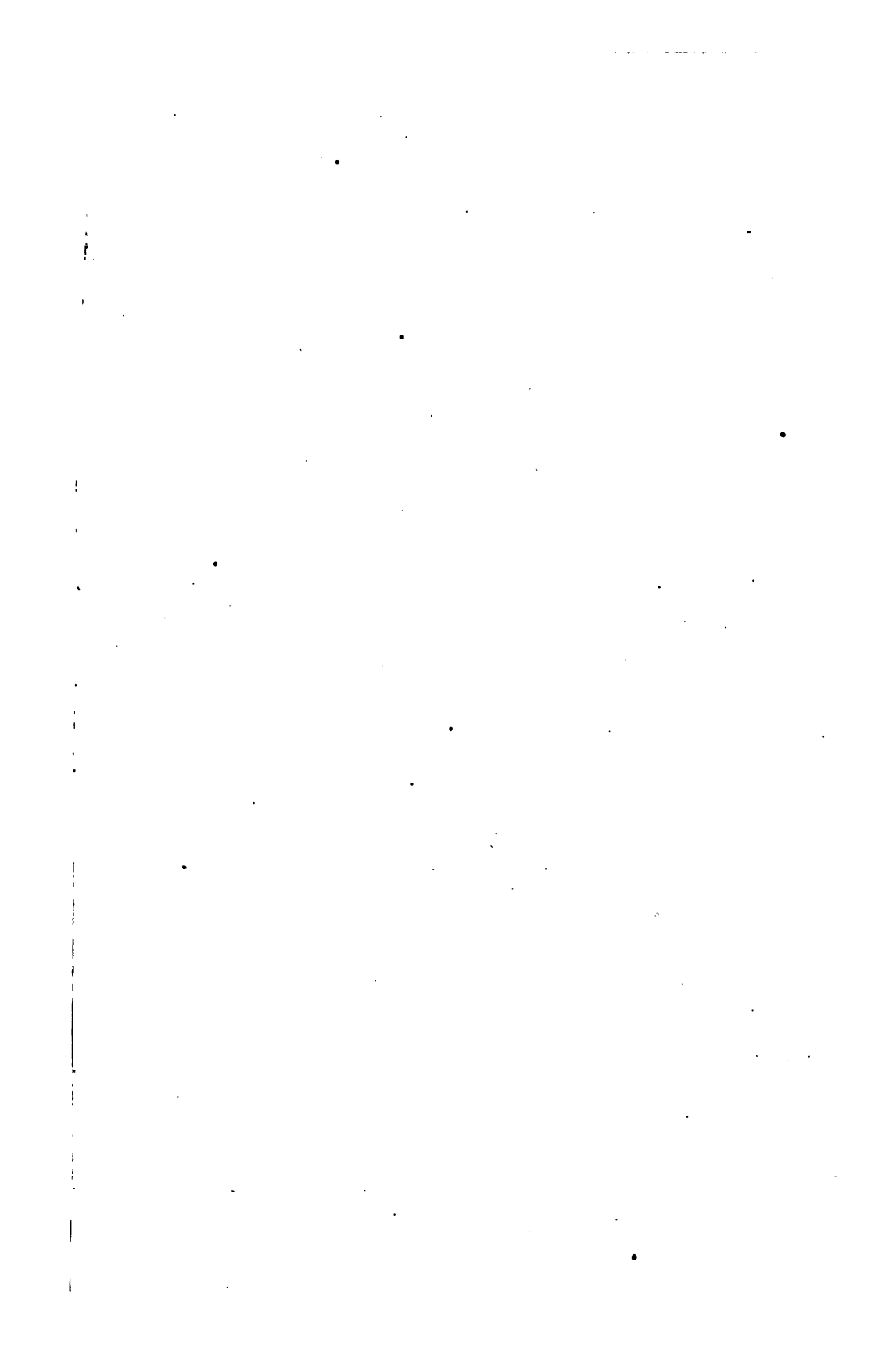
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ON THE
VENTILATION
OF
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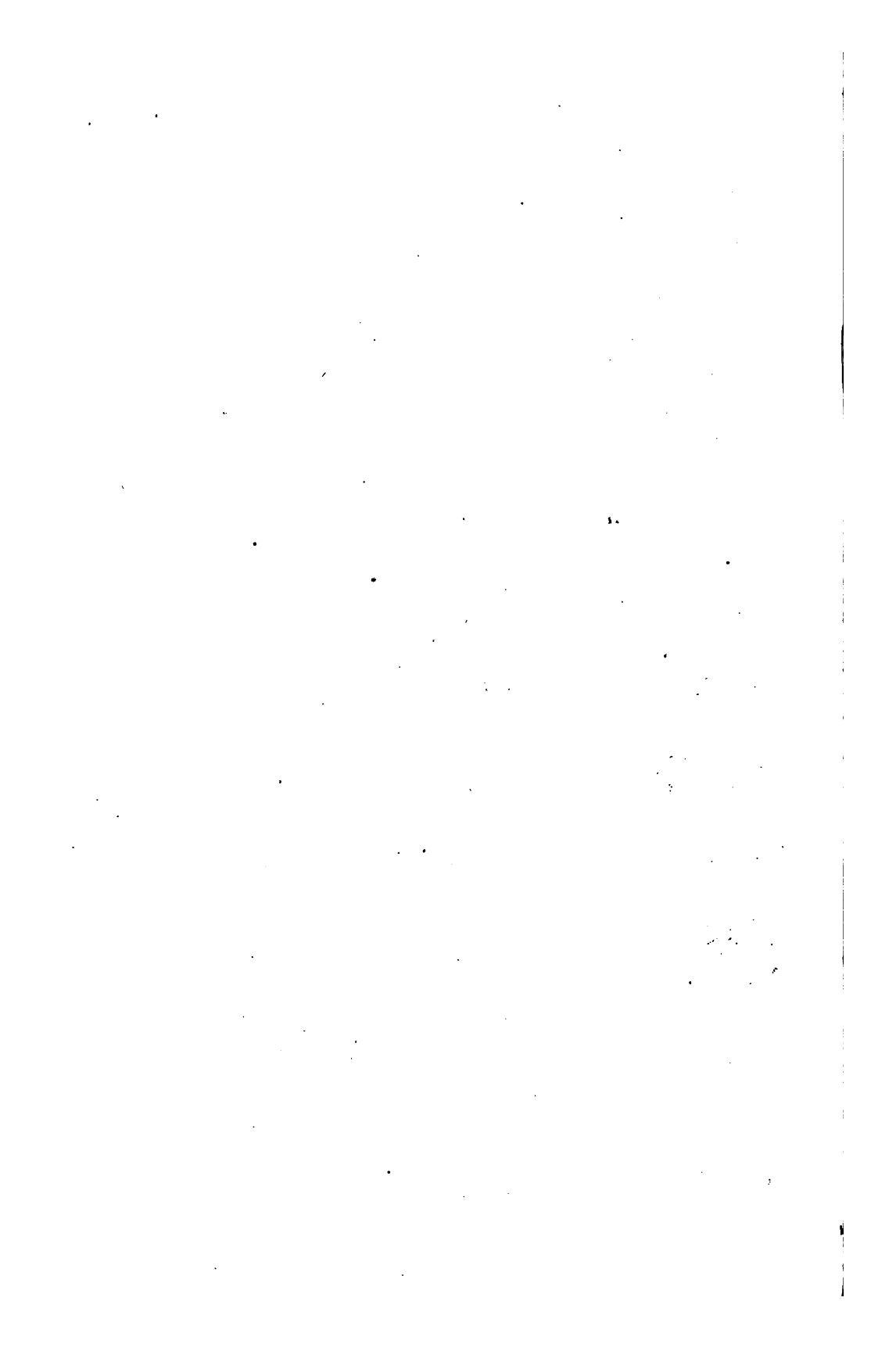


William Routh Esq^r

With the kindest regards and
wishes for many happy years to him -

Ben^y Gibbons

January 1. 1847



Gibbons, Benjamin

ON THE

VENTILATION OF MINES;

AND ESPECIALLY OF

THE THICK OR TEN-YARD COAL MINES

OF

SOUTH STAFFORDSHIRE.

BIRMINGHAM:

WRIGHTSON AND WEBB, 8, NEW-STREET.

1847.

MONROE
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TO

PHILIP WILLIAMS, ESQ.

A MAGISTRATE OF THE COUNTY OF STAFFORD, &c. &c.

My dear Sir,

05-29-321574
THE mutual esteem, and [REDACTED] friendship, which have uninterruptedly existed between us for the long period of Thirty years, have naturally suggested you as the person to whom I should wish to inscribe this little Work; and you have added one more to the numerous favours I have received at your hands, by permitting me to do so. But apart from this, as an extensive Proprietor of Mines your name will stamp it with an additional value, and your character and influence will essentially promote its success. Your patriotic services as a Magistrate, and the disinterested zeal you have always shewn in forwarding every measure that is calculated to advance the welfare of Society, and to assist every benevolent object, give me the fullest assurance I shall not want your support. That you may continue to benefit the world by your meritorious exertions, and enjoy health and happiness for many more years than I can hope to see, is the sincere wish of,

My dear Sir,

Your obliged and truly,

BENJAMIN GIBBONS.

Shutend House, near Dudley,
December 16th, 1846.

[REDACTED]

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P R E F A C E .

THE late frightful calamity at Oldbury has attracted my attention to the urgent necessity of uniting our efforts to prevent the recurrence of such deplorable events. I had hoped that some one of the many practical and well-informed individuals engaged in Mining operations, would have stepped forward to allay the painful impressions produced in the minds of Society in general, by holding forth some *hope*, at least, that a remedy would be speedily discovered. The interests of humanity and the Public Voice alike demand that we should join our endeavours to terminate (as far as it is possible) the frequent sacrifice of those valuable lives which we have so much reason to lament. The general interest displayed by *all* classes, since this melancholy disaster, does not allow me to doubt that the benevolent efforts of *all*, and especially those engaged in the operations of Mines, will be freely afforded to recommend and adopt *that system* of working the Thick Coal which will ensure the *greatest* degree of safety.

It is this object alone which has incited me to bring forward this little Book; for I can truly assert that no principle of Vanity has induced me either to write or to publish it. When I first descended into our Thick Coal Pits at the Level, about Forty-five years since, I found the Gate road and the Air head driven side by side on the Floor of the Mine. No other practice had prevailed to that time as far as I could ascertain. It appeared to me, in a very short period, that this *must* be founded on erroneous principles; but it needed no small sacrifice of time and patience to persuade the Workmen (even to a very partial extent,) to be of my opinion. At length by authority, more than by persuasion, I succeeded in raising the position of the Air head so far that the bottom of it should be on the same level as the top of the Gate road. Since that period, we have climbed Six feet higher, or to about the middle of the Coal; and henceforward I trust we shall mount "per saltum" to the top of it. I have endeavoured to explain how this can be attained, and also to demonstrate a *combination of practical* means, calculated to establish a *system* of safe ventilation. Having found it effectual in Thick Coal, which yields as great a quantity of Gas as any that has fallen under my notice, and, I believe that I may say, as much as any that is found in this district; and having succeeded in opening this Coal so that it is now perfectly clear of Gas.

in every part of the workings ; having, I say, this fact and result before me, I believe I am fully justified in recommending the same plans to the adoption of others. If any better should be proposed, I shall be found one of its warmest advocates ; for I hope that I have learnt the maxim “ *Suum cuique tribuere,*” as one which never (either from feelings of vanity or envy) should be forgotten by me or any other man. Many faults, and possibly some degree of obscurity, is inseparable from the nature of the subject. I have been as sparing of “ technical ” terms as possible ; but without using them in the course of my explanations, it would have been very difficult to make myself understood by many of those *for* whom this work is principally designed, and *upon* whom it is most essential to impress those clear ideas of the details, which must be fully comprehended before any man could attempt to establish the *System*.

The different methods of getting mines I have not entered upon in detail ; for it could only serve to distract attention, and it is a field far too extensive to combine with the object of this work. I have therefore endeavoured to confine myself, as strictly as possible, to one single point ; that of describing and promoting some *safe system of ventilation*. I have written “ *currente calamo,*” and many faults and omissions may perhaps exist, which, had time permitted, I should have been glad to repair and

supply. Still I hope that, if not wholly successful, I shall have thrown at least a ray of light upon that mysterious gloom which has hitherto obscured our view, and frustrated our attempts to establish any *practical* rules to obtain a safe *system* of Ventilation *throughout* our Mines of Thick Coal. If the execution of my work shall be found faulty; the consciousness of a good purpose will still remain to console me for my failure.

BENJAMIN GIBBONS.

Shutend House, near Dudley,
December 12, 1846.

ON
THE VENTILATION
OF
MINES.

ERRATA.

- PAGE 7.—“*precede*,” not proceed.
— 11.—“*ample*,” not sufficient.
— 22.—in Note, “*rotten*,” not rotton.

*** Any profit arising from the sale of this Work is intended
for the Benefit of the South Staffordshire Hospital.

~~every human heart, and as a consequence~~
that they may be at once greatly diminished, and
eventually almost entirely prevented by the adop-
tion of a better system, it would be highly blame-
able on my part (having this conviction) to withhold
a knowledge of the means which the experience of
many years has proved to me, to be fully adequate
to afford effectual protection to our Workmen against
the recurrence of such frightful calamities.

That many sources of possible accident, and many of them beyond our control, will still remain in working a Coal of thirty feet in thickness is most true ; but those can only be guarded against by the unceasing exercise of the skill and vigilance of a well qualified Under Ground Surveyor, aided by the care and attention of the Charter Masters and Workmen employed. But it is then the more incumbent on this account, on our parts, to provide against those dangers which we alone can remedy, especially that most appalling of *all* dangers the imperfect ventilation of the Mines. This being removed, a great diminution of the other accidents which indirectly arise from it would soon be experienced. The Gas, (or Sulphur) as it is termed by the Workman, which produces these dreadful explosions is Carburetted Hydrogen, and is very nearly the same as the Gas distilled from Coal by the Gas Works for lighting our streets and buildings. This Gas is not explosive until it is united with a certain proportion of ordinary Air ; say seven to nine times its volume ; when this mixture has taken place it arrives at what is termed its “firing” or explosive point, and in that state, if it comes in contact with the flame of a candle, will instantly explode with the same rapidity and violence as Gunpowder. A considerable volume of this Gas is set at liberty in all our thick Coal Mines, as often as we cut through fresh masses

of Coal. Some Coal Mines supply a much larger quantity than others, and these are vernacularly called "Fiery Mines;" but in all our Coal Mines a sufficient quantity is extricated to produce the most direful consequences, if it is not neutralized or its escape not duly provided for. The only effectual mode (practically speaking) is that of diluting it with a quantity of atmospheric Air; and a current of Air equal to thirty or forty times the quantity of Gas yielded by the Coal is the bare limit of safety. That is to say, thirty or forty cubic feet of common Air must circulate through the Mine in the same space of time that the Coal will give out one cubic foot of Gas; but the quantity of Air must greatly exceed this; for a copious supply is needful for the numerous Workmen, Horses and Candles employed in the Pit. We have had as many infallible nostrums recommended to us for supplying this quantity as we have recipes for the bite of a mad dog, and melancholy experience witnesses their equal futility. Some recommend Air Pumps to force Air in; others exhausting Pumps to suck the Gas out; and thus produce *artificial*¹ currents of Air throughout the workings.

1. Let me here protest "in limine" against *all artificial* modes; and in this category I include *Fire*. I condemn them "in toto" as snares and delusions under the Guise of protection. Fire for the purposes of rarefaction of the Air, may be in some circumstances an useful *auxiliary*, but can never be relied upon

These plans no doubt sound very plausibly, and theoretically may be very true; but in their practical application they are at best but worthless.

The Engine that works the Pumps may get out of Order; a Rod may break, a Valve may obstinately stick open when it ought to shut, and then what becomes of the lives of those individuals depending upon the due action of every part of the Machine. They are hurried into eternity without a moment's warning, leaving their numerous families in destitute misery.

Can any one say that we are justified, in the sight of God or man, in suffering the present state of things to exist for a moment, if a remedy can be found? If it can be shewn that by availing ourselves of an unerring and invariable law of Nature, we can effectually guard our workmen against the greatest of their dangers? The universal answer must be "Certainly not." The object of my work, then, is to shew that we have such means within our reach; that we can practically enlist such a principle into our service, and that it is fully adequate to give us the desiderated protection we so much require. I need not tell my readers that the Carburetted Hy-

for a *protector*. It may be "*out*" when it ought to be "*in*," and, then, what becomes of the family committed to its guardianship? By the term *artificial* I mean all *power* of ventilation which is *not* self-acting; but requires the action of machinery or the constant *aid* of men.



drogen (of the Mines) is seven or eight times lighter than common air. It will always rise to the highest parts of the Mine; and would escape with great velocity if permitted to do so; and we will proceed to see how far this is provided for by the usual practice.

Plate I A Colliery is about to be established, where the Coal lies at a depth of One Hundred and Forty yards. The first step taken is to sink down two round Pits or Shafts (say) of Seven feet diameter each; these Shafts commence upon the *same* level, and terminate at the *same* level when completed. In the progress of sinking, thurls or openings by heads from shaft to shaft are found necessary every Twelve or Fifteen yards to supply the Sinkers with air. It is obvious that there is no *natural* reason, why the Air should ascend one of these Pits in *preference* to the other. And the fact is, that no man can predict before hand which of these Pits will become the "downcast Pit," or that *down* which the Air will descend; or which the "upcast Pit," or that *up* which the Air will ascend. It is quite true that it is generally found that the current of Air *will* descend one Pit and ascend the other; but the determining cause is so faint, that it is liable to be deranged by the action of the wind or by Atmospheric changes (such as those alluded to upon the late inquest at Oldbury, under the term "heavy

state of the Air,"') nay, it sometimes happens that the Air becomes actually quiescent, and it becomes a mere unsteady column and ascends or descends neither. Sometimes it will alternately ascend or descend; and then in Miner's language the Pits "fight," that is to say, the Air will neither ascend or descend with regularity in *one* direction; but at intervals the downcast Pit becomes the upcast Pit and "*vice versa*."

But worst of all, the course of the Air will be sometimes inverted or "turned;"² that which should be the downcast Pit becomes the upcast

2. And I will here, for the *first* time (for I shall again speak of it) confidently assert that this must be always the case whilst the upcast Pit, or as it should be called the "*Air chimney*," is used as a *working* pit. The upcast Pit, which is in fact the *main* air way, and which ought always to be closed from the external air, and which ought also to be guarded from disturbance or commotion, to prevent the slightest *interruption* to the current of air (on which the lives of all depend) is kept in a state of constant agitation by the ascent and descent of the skips loaded with coal which nearly fill the shaft. To crown this, when every Skip arrives at the top of the Shaft, a Carriage (boarded over) called the runner is wheeled over the mouth of the pit whilst the coal is landed, and then withdrawn to allow the Skip to descend. Is it not obvious to common sense, that the air (which as I before said should never be disturbed) is thus constantly in conflicting currents, sometimes upwards, then downwards, and whenever the Mouth of the Pit is impeded by the Runner in a state of *partial* Stagnation. But it sometimes occurs that the Chains or Tackles by which the Skip is suspended *Break* during the ascent; the Skip drops down the Shaft, drives the air before it with great velocity along the Air head, and forces the Gas in the workings *downwards* upon the candles of the workmen, and this I have known happen more than once. Just let us suppose then: Mr. A. very naturally argues thus; "If this is right in the chimney of my Pits, it must be equally right in my chimney at *Home*." He posts off, and orders John to bring a ladder, and to arm himself with the Coal Hod or a Furze-bush tied to a rope; to draw this up and

Pit, and the fearful possible results of this, when the workings have been opened, I shall hereafter describe.

We will now suppose the Pits are sunk down through a stratum of Coal Thirty feet in thickness. We then proceed to drive a Gate road or Horse way in the *bottom* of the Coal Nine feet wide and Eight feet high, commencing from the bottom of the down-cast Shaft. At the same time (or rather before) we commence an Air way (as it should always a little *precede* ~~proceed~~ the Gate road) about the *middle* of the Coal or only Fifteen feet high from the *Floor* or *bottom* of the Coal. This Air head commences from the upcast Shaft. The Gate road and Air way are then driven in parallel lines at the same level upon which they commence for the distance of One or Five hundred yards, according to the quantity of Coal intended to be cleared by the Pits. It is necessary to drive Spouts or openings from the Gate road *upwards* into the Air head at intervals of each Ten or Fifteen yards (as the Coal may give out more or less Gas)

down the chimney, and at intervals to partially close it by placing a board on the top. The House is of course instantly filled with smoke, and out sallies Mrs. A. and finds her Husband thus employed. Mrs. A. "Why, good Heavens, Mr. A. have you a mind to *Smother* us all? what are you about?" Mr. A. "About, my dear! why making the Chimney *draw* to be sure." I am disposed to think that Mr. A. will be soon taught that he is not to play such pranks at home, if he perpetrates them abroad. If this illustration is an homely one; it is *literally* true; and its very homeliness will make our practice more intelligible to those I wish to inform.

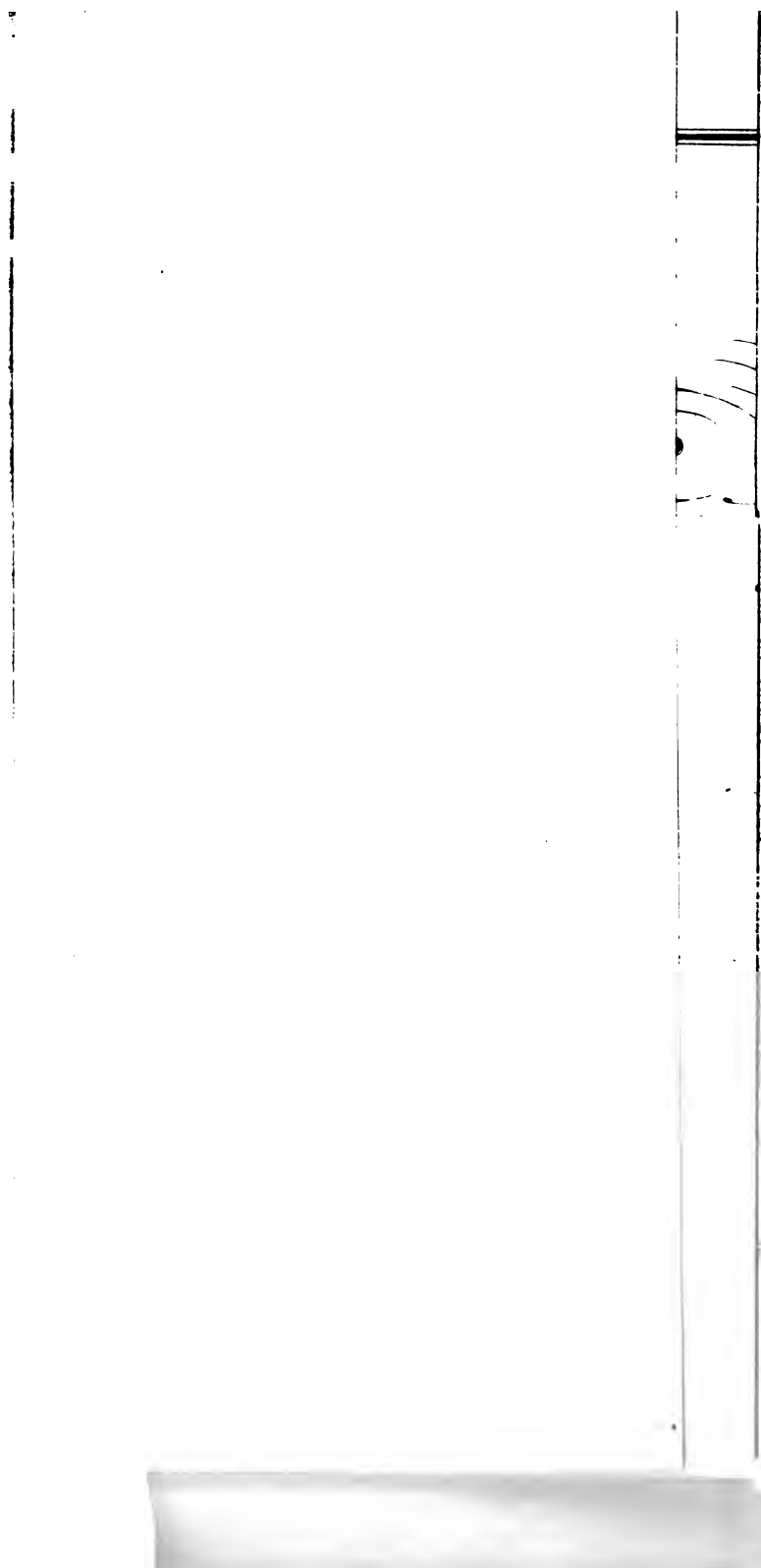
to carry off the Gas and produce a current of air for the Workmen. Having arrived at the farthest point at which it is intended to get the Coal, the Gate road is driven at a right angle to its former direction, accompanied as before by the Air head. When it has proceeded Ten or Fifteen yards to pass through a Rib which is to be left for the support of the Gate road and Air head, the Gate road is then stopped. The preparatory measure (of opening right and left from the end of the Gate road, or, as it is then called, Bolt hole) for making a Side of Work, ~~or ex-~~ cavation of the whole thickness of the stratum of Coal (Thirty feet thick) begins. This side of Work forms a square cavity which we will take at Ninety yards by Fifty, or in round numbers, about an acre. And the whole of the Coal as far as practicable is taken away, save and except the pillars of Coal generally Ten yards square and Ten yards distant; which are left to support the superincumbent strata. A Side of Work when excavated will very nearly represent the interior of a church, or more nearly the interior of the Indian Temple, still in existence in the island of Elephanta, which our cheap publications have made tolerably familiar to many. Though rather out of place, I will here observe, that after the Coal is extracted a solid wall or Rib of Coal must be left around the whole of this square room; and the right angled Gate road called the "Bolt

hole," which is in fact the "Door way," securely walled-up to exclude the air and prevent spontaneous combustion, which would otherwise in a short period take place. I have necessarily been rather minute, even perhaps prolix, in this description, that those who are only partially acquainted with Mines may have a general notion of the nature of the operations. And now we come to the important part ; and have to learn whether any effectual means have been contrived to ventilate safely and effectually all these roads and headings, together with a cavity containing more than One Million cubic feet of space ; and in addition to this, to carry off the Gas incessantly issuing from the Coal, and which requires, as I have before said, so large a supply of air barely to render it innocuous. Well ; we commence, undergoing the Coal from the bottom and dropping it down in large masses, and provided we *had* a current of Air sufficiently powerful, and upon which we could rely, we go on pretty well till we have removed Fifteen feet in thickness ; but *then* we have arrived at the top of the Air head. To this period the Air descending the downcast Pit and travelling along the Gate road into the Workings ; *ascends* to the Air head, and traversing that, ascends the upcast Pit, carrying with it the Gases and all other impure Vapours, and delivering them into the open Air. Supposing we could *command* a sufficiently powerful

current of Air (which by the mode in present use we *cannot*) the means employed would be sufficient to allow the safe removal of *Fifteen feet*, or *half* the thickness of the Coal. But at this point we should stop. The Air head is no longer of the slightest service ; for any cavity made above its *level* (and every additional removal of the mass of the Coal forms hollows above that level) is instantly occupied by Gas which is beyond the reach of the current. The result is that a reservoir of Gas is hollowed out having a capacity of Four hundred thousand cubic feet floating upon the surface of the Air beneath, in parts perhaps mixed with it, but never entirely removed. But even in the part of the Mine said to be ventilated, what *impelling* power have we to force a sufficient current of Air to travel in *one* and the *same* direction to the necessary points we require ? *None* whatever, that we can repose the slightest confidence in ; and the best proof of this is, that the present means are found inadequate, and that the current is by no means capable of overcoming the action of the Wind, or counteracting the changes of the Atmosphere. What should we say to a man who provided no means of *draught* for the smoke of our Houses or our Steam Engines, and gravely told us we might do very well without any ; and yet we have *real* dangers to conquer, much more serious than the Smoky Chimney, even with the proverbial addition

of a Scolding Wife. Just let us imagine what may, and does now and then, happen, viz :—that the up-cast shaft becomes the downcast; should this occur the Air is inevitably driven along the Air head into this Magazine of Gas, and as soon as a portion of it is brought to the firing point, it is carried downwards along the Gate road, meets with a candle in the hands of a Workman, and at once explodes. Again, let us reflect for a moment what a tremendous mass of mischief *may*, under certain circumstances, be brought into action. I have already shewn that we have a vacancy of Four Hundred Thousand cubic feet *above* the Air head, and that this may be wholly or in part occupied by Gas. If it were possible that the whole of this could be brought to the firing point at the same moment of time, the consequences would be too fearful to contemplate; but we have ~~suffi-~~
ample ~~cient~~ proof that a portion sufficient to produce the most destructive consequences is sometimes in this state. Thus we see that the first explosion is generally followed by a second or more; as portions of the Gas become successively charged with the due proportion of Air; and until this is overpowered by the Carbonic Gas formed; and then the unconsumed Hydrogen streams in flames from the mouth of the Pit. The liability to these terrible explosions will always remain; till, by some *natural* means a current of Air can be *compelled* to clear out every

cavity formed : and this current *must* move in *one* and the same *required* direction, and this current also *must* have *sufficient* power to overcome all extraneous forces ; either of the Wind or any Atmospheric change. It must be also copious enough to neutralize all the Gases produced, as well as to supply the numerous Workmen, Horses, and Candles necessary to carry on the works. But these conditions *cannot* be fulfilled under the present system ; and further, even if we *had* this current of Air, it would be *useless* so long as we persist in using the upcast and downcast Shafts as *Working Pits* ; or, as is almost universally the case, *drawing Coal* at *both* of them. In the first place (if so used) communications must exist between the Pits intercepted by doors only, which must be perpetually opened and shut to allow the passage of Horses and Workmen ; and the current of Air is thus interrupted, which never ought to be ~~dis~~turbed for a moment. But suppose that by the Carelessness of a Boy (*a very* frequent occurrence) the Doors are left *open* ; the Current of Air, even if sufficient, is instantly cut off, and the men *may* be blown to atoms in spite of their most careful precautions. I am quite aware that this method prevails in other districts to as great an extent as in our's ; but wherever it is found I denounce it as subversive of *any* system that could be adopted for safe and effectual ventilation.





I have described the evils arising from the ascent and descent of the Coal in the *upcast* Shaft in Note 2, and need not dilate upon it further in this place. But I shall here stop ; and having shewn a *sufficient* number of the radical faults of our *present* system no farther details are required, though I could without difficulty swell the list. Every candid and impartial person acquainted with the subject, will admit that I have rather *under* than *over* coloured the sketch.

Plate No. 2. I shall now proceed to describe the system I have adopted, and have in operation with the fullest success. We will suppose, as before, that a Colliery is about to be opened, where the depth of the Coal is One Hundred and Forty yards. Instead of sinking two Pits, I sink only "ONE."³ In the side of

3. Where large quantities of Coal are to be drawn a number of Shafts are necessary. Two of these may be sunk at the usual distance of Ten or Twelve yards, near enough to be commanded by the same Winding Engine. I am now sinking two in this manner. But if the form of the Mine makes it more convenient, they may be sunk *singly* in any required situation, because each separate Pit will provide *its own* Air. Indeed my principle is, that each Pit *shall* be supplied by the action of *its own* Air Chimney ; or if an additional Shaft is preferred to my Air Chimney, that this shall be kept *closed* till it discharges itself into the Ventilating Chimney and used for no other purpose. I have one Pair of Pits (as they are usually called) getting Coal ; and I have another pair sinking at a distance of Twelve yards from each other. But each Pit provides *its own* supply of air, and each Pit will get the *separate section* of Mine appropriated to it. By this arrangement a much smaller quantity of Air heading is required to get the same Area of Coal, and the process of Ventilation is simplified.

On this plan each Pit has *that* Coal brought to it which comes from *its own* Section *only* ; and by this means although communications may be had by the

this Shaft I cut an oblong Channel, large enough to allow a space of Two feet square ; or an area of Four superficial feet, or otherwise of Three feet by Two feet, or an area of Six superficial feet, in both cases the Air Chimney to be of these dimensions when the Channel is lined with brick. This is done simultaneously with the sinking of the Shaft, and it does not impede the rate of sinking, as one additional man has room to work in it, and he keeps pace with the sinkers of the Shaft. The expence of cutting the Channel containing Four superficial feet (which I have found sufficient⁴ in my Coal) does not amount, at the present high rate of wages, to more than Five or Six shillings per yard. When the Shaft is bricked, this Channel is also bricked, and

Gate roads which is often convenient ; these communications may be under the care and control of the Charter Master ; who may keep the doors (made nearly Air tight) locked if he thinks proper. The Ventilation is thus not materially disturbed.

4. My Coal at King Swinford (being contiguous to a great fault) abounds in Gas to a greater degree than any Coal I have worked during an experience of more than Forty years ; the general belief was, both in the Pits nearest to me, and in the neighbourhood, that if worked at all, it would be with extreme difficulty and imminent danger. I have found an Air Chimney of Four superficial feet, which discharges itself into a Ventilating Chimney Sixty feet high, amply sufficient to vanquish all difficulties, and no Mines need be freer from Gas than they now are. The system will seldom undergo a severer test. Nevertheless Mines still *more "Fiery" may exist* ; and the drawings shew an Air Chimney of Three feet by two feet, or Six superficial feet, and a Ventilating Chimney Ninety feet high. The difference of expence in building the Ventilating Chimney Ninety feet high instead of Sixty feet is not considerable, and I have adopted this at my new Pits ; for this increase of height adds greatly to its power of draught, as exemplified in our Engine Chimneys.

the circular brick work of the Shaft closing its front, it forms a separate compartment (*or Air Chimney* as I will, for the sake of distinction, hereafter call it) from the top to the bottom of the Shaft, and sufficient to carry off any current of air required in the Mines. The Men have then always an abundant supply of air *with* them. The efficiency of the Air Chimney is displayed in sinking the Shaft. When two pits are sunk in the old mode ; after a quantity of gunpowder has been fired in blowing-up such measures as require it (and most of them do) a considerable space of time elapses before the smoke is sufficiently dissipated to allow the Sinkers to descend and renew their work. But when the Air Chimney is used the Smoke is at once dispersed, and before a man can reach the bottom of the Shaft, it has been carried away by the air.

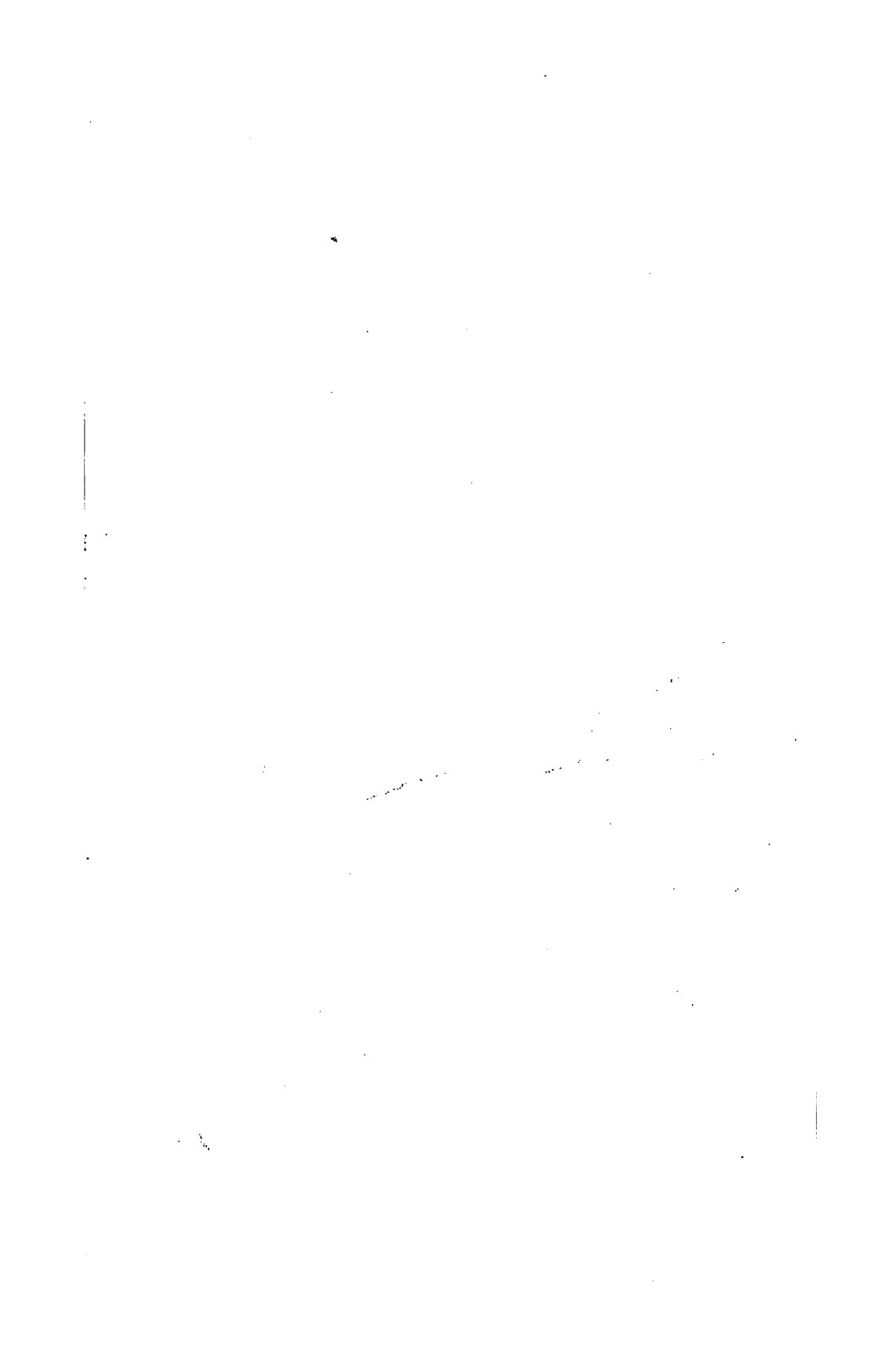
Let us now imagine that the Pit (delineated in Plate 2,) is sunk down through the Thirty feet of Coal ; a Gate road or Horse road is then commenced from the *Shaft* ; and an Air head from the *Air Chimney*. The Gate road is driven at the *bottom* of the Coal, and the Air head at Twenty eight⁵ feet (where the Coal is Thirty feet thick,) above the *Floor* of the Mine ; instead of Fifteen feet as shewn in Plan No. 1. But if the Coal is less than Thirty

5. The height of the Air head denotes in *each case* the *top* of the Air head, as the drainage is *effectual* to the *top* of the Air head, and even a little higher.

feet thick, still the Air head should be (if practicable) in all cases within *two* feet of the *top* of Coal. The Gate road and Air head are carried forwards as before described, to the extent to which you may design to get the Coal; and then the Gate road is turned at a right angle, as in the old plan, to begin a Side of Work. The drawings shew a side of Fifty yards by fifty yards, as it diminishes the size of the plan and explains the principles equally well. But these Sides are worked Seventy yards by fifty yards; or Ninety yards by fifty yards, which contains an area of about an Acre, or One Hundred and Ten yards by fifty yards; where the Coal is good and other circumstances favourable.

In driving the Gate road and Air head it is necessary to make Spouts⁶ or openings *upwards* (as before described in Plan No. 1, to connect the Gate road and Air head,) at every Fifteen yards; but the

6. These Spouts can only be driven perpendicularly *upwards* from the Gate road to the Air head. Each of these being Sixteen or Seventeen feet in length, a formidable practical difficulty arose in the King Swinford Pits. In the old way the Spouts being very short the difficulty was not so serious; it *could* be done. But my Coal at King Swinford proved a *very Gaseous Coal*, and I found that when the Spout was carried up a very few feet, that it became so filled with Gas that no man could work in it. It then occurred to me, to *commence* the Spout, and then bore *upwards previously* a Hole Four Inches diameter *into* the Air head. This is only a few Hours work, and the moment the borer pierced into the Air head, the Gas *fled* off instantly, followed by a Stream of Air sufficient to air the Gate road, and to enable the men to work with Candles, in the Spout, in perfect safety. If I had not devised this plan, the difficulty would have been *insurmountable*, by any means ordinarily employed.



current of Air being more powerful it is probable a Spout at intervals of Eighteen or Twenty yards would be found sufficient. The excavation is now commenced and continued ; and when the lower measures of Coal (one half) have been cut down ; the difference of the plans (though apparent enough before) becomes more apparent. In the old way the upper half of the Coal is *never ventilated at all* by the *Air head* ; and as the Coal is removed the space becomes filled by Gas, which is liable to become, as I have before stated, an immense Magazine of destruction. But in the plan I am now describing, the Air⁷ head opens into the *Top* of the Cavities, the *whole* of which are effectually ventilated ; and indeed the Gas is carried off by its own levity, as fast as it is released by the removal of fresh masses of Coal. But the quantity evolved by the removal of these masses of Coal is by no means so great as in

7. I will take this opportunity of requesting the Reader to observe, that by the word "Air Head I designate the horizontal heading opened for the passage of the air from the excavation to the *bottom* of the "Air Chimney." The term "Air Chimney" means the perpendicular Chimney or Flue carried up the side and *separated from* the *Shaft* by the circular Brick lining or Casing of the Shaft ; and that the "Ventilating Chimney" is the Chimney erected upon the surface. It will thus be clearly comprehended what I am speaking of when these terms are used. I have described the Spouts as the openings made perpendicularly *upwards* for the passage of the air from the Gate road to the Air head at intervals ; these are only temporary, and used whilst driving the Gate road ; for when a new Spout is made, the one behind it nearest to the Shaft is bricked up ; that the air may still be carried forward along the Gate road.

the usual way of working, for the following reasons:—It will be observed that the Coal is entirely pierced throughout its *bottom* by the Horse or Gate road from the shaft to the excavation; it has also been similarly pierced in the same direction by the Air head, driven only Two feet below the *Top* of the Coal. The Gate road and Air head are united by the Spouts or *Perforations* which cross *all* the strata lying between the *two*; as if you lay a ladder upon its side, you will see the steps or rounds connect the two sides, which will give you a good idea of the Gate road and Air head united by the Spouts. It resembles the operation of draining a bog of its water when you have cut two main parallel drains, and joined them by cross drains, thus dividing the surface into a series of square masses. But the Gas will escape with far greater *facility* than water; which is a circumstance greatly in favour of rapidly *draining* the Coal. Having advanced thus far, we see that in Plan No. 1. only *one half* of the Coal is ever *ventilated* or *drained* of its Gas, and that in Plan No. 2. the *whole* of the Coal is effectually cleared, and this arises from the different heights traversed by the Air heads. But I shall now come to another important part of the subject; we have seen in what manner the ventilation *is* conducted, and we shall see in what manner (as it appears to me) it *ought* to be.

From what I have before stated it is manifest,

that, by the usual mode of ventilating the Mines, no *determinate power*⁸ *compels* the Air to travel in *one* and the *same* direction. Its current is at all times weak and insufficient, and it is always liable to be deranged by the action of the Wind or Atmospheric changes; and it is under no *command* whatever. It must be evident to any one, that to ensure safety, a permanent and *abundant* current of Air is indispensably necessary; It must be a current created by *natural* causes, and that shall never vary or fail. To effect this; the Air of the *ascending* Column must be rendered specifically lighter than the Air of the *descending* Column which circulates through the Workings; this is accomplished by giving to the *ascending* Column a length and *height* that considerably exceeds the length of the descending one. *This* is the object, and I attain it thus :—I erect a Chimney from Sixty to Ninety feet high on the surface, which I call my *Ventilating Chimney*, and with this I connect my *Air Chimney*, which it will be recollected is already in communication with my *Air head*. My apparatus is now complete, and a *self-sustaining* action, that will know no pause, is established and secured. By a re-

8. The weak power of draught that exists in the old system is materially diminished by the *upcast* Shaft being open to the external air; and thus *cooled* down *below* the temperature of the air which has travelled through the mines; the effect of this is obviously most injurious.

ference to Plan No. 2, the “modus operandi” becomes evident; it will be seen that, in the first place, the Air descends the Shaft, traverses the Gate road, and sweeps around the Workings, as denoted by the Arrows on the Plan; and in the second place, it finds an exit by returning along the Air head, and proceeding up the Air Chimney collateral with the Shaft, and then into the Ventilating Chimney that crowns it; the *Circuit* is thus completed, and all the noxious Gases of the Mine are safely driven into the upper regions.

My ventilation is thus secured by the operation of a *law* of *Nature*, and it will never fail you; for the power or *draught* (to use a familiar term) of the *Ventilating Chimney* is sufficient to defy Wind or Weather; and also to produce a current so powerful, that you may split or withdraw from the main stream of Air such portions as may be found necessary to carry on the preparatory work to maintain the Get of Coal.

This power is indispensable in a *Pit* which is to get Seven Hundred and Fifty tons per week; which is my usual get; and this cannot be regularly done with the weak and languid current of Air circulated by two Shafts; and scarcely ever without danger.

By the means I recommend, a powerful current of Air is obtained which you *command* at *pleasure*; and having this, every operation can be carried on with

facility and safety.⁹ Cases may occur in which it may be desirable for *temporary* purposes to *increase* the *draught*; this is at once attained by adding a Furnace of any required power to the Ventilating Chimney. By means of a Fire in this furnace you may produce *any* degree of rarefaction in the Ventilating Chimney that you wish, and I generally build one to mine, to be used if it is wanted. But provided you do this, it is proper to carry the flue of the furnace perpendicularly *upwards* for Thirty or Forty feet against the side of the Ventilating Chimney, before it is opened *into* it; this precaution will render a deflagration of the Gases passing up the Chimney impossible. But I earnestly enforce the necessity of having the *draught* of the Ventilating Chimney of sufficient power for all ordinary purposes without the *aid* of *Fire*. If necessary, your *draught* may be made stronger by increasing the *height* of the Ventilating Chimney.

9. The Air in the Gate road and Workings is warmed above the Temperature of the Air on the surface by the Heat of the Earth, and consequently rarefied; this is aided much more then would be generally imagined by the Heat proceeding from the numerous Workmen, Horses, and Candles employed in the Pit; and further by the Gases which are specifically lighter than the Air. The Air head being unbroken and continuous by the intervention of the Air Chimney, from the Workings to the *Top* of the Ventilating Chimney where the Air is less dense than upon the surface; a very powerful draught is constantly maintained sufficient for all our usual purposes. You can always increase (as I have stated in the Text) the *draught* to any degree, by rarefying the Air in the Ventilating Chimney by the *assistance* of Fire. I have stated my reasons elsewhere against placing any reliance upon *Fire* as a *permanent* means of *Ventilating* the Mines.

It is no very formidable matter to build a Chimney Twenty or Thirty feet higher; and we must hold ourselves in readiness to encounter much more serious outlays than this will occasion, before we attempt the "*Plant*" of an extensive Colliery. But it is generally very practicable to make use of the Chimney of the Winding Engine as a Ventilating Chimney, provided that it is built (as it uniformly is by me) Five feet square within, or containing an area of Twenty-five superficial feet. This being always in a heated state, acts very powerfully and efficiently; and all the precaution necessary to take is, to divide it into two equal parts by a wall of Four inches in thickness to the height of Thirty feet. One division then *ventilates* the Pit, and the other is appropriated to the Fire of the *Boiler*. But in case of repairs of the Boiler or its Brickwork, the ventilation *may* be for a short time *disturbed*; and although I do not expect any danger would arise, such is my objection to any breach¹⁰ of the *system*,

10. I am perfectly aware that on many occasions *temporary departures* from the rules laid down are *unavoidable*, but these cannot be termed *breaches* of the *System*. Slips, up and down casts, mucky or Rotten Coal, interpose obstacles which must be removed or provided for in the best manner that the skill and experience of the Ground Bailiff and Charter Master can discover; for in such cases no rules or regulations can be insisted upon. But let us never lose sight of the *principles* laid down; but abridge any *necessary departure* from the *system*; and re-establish it as quickly as possible by every means in our power. I may as well state here that an Air Chimney may be very easily cut down any Shaft which has been sunk in the usual way. I have cut them down a Shaft during the Night whilst the Pit still continued to draw Coal during the Day. In

however slight, that I would prefer having a separate Ventilating Chimney to important Pits.

I believe that I have now sufficiently described the nature of that *system* of Ventilation that I have actually in successful practice; and that I have so far explained its details that it will be understood by all those to whom the getting of thick Coal is familiar, and that even to those who are not so acquainted, the present system will be stripped of that mystery which has so long shrouded it. If upon examination it is *proved* that by the application of a *natural* law, the ventilation of Pits can be so conducted as to make them safe from the explosions of Gas, that have destroyed so many valuable lives and desolated so many hearths, it is not to be doubted that the Public voice will compel the adoption of it as a System. It has upon various occasions, lately, been suggested that the interference of Government is desirable; but I entirely dissent from this opinion. Any interference in the power of Government could *not* be efficacious,¹¹ and *must* be a constant source of

a Shaft which is in part coffered some difficulty might be found, but I think few cases would occur in which I could not master the difficulty. When this does ~~not~~ ^{expense of} occur the cutting out an Air Chimney is not considerable.

11. Two Commissions (if not more) have already been appointed and have made reports. An investigation under the Authority of Government was made last year by Sir H. de la Beche and Dr. Playfair, in consequence of the dreadful event at the Haswell Colliery by an explosion of Gas. The report contains a great mass of valuable Information, and is worthy of the eminent men by whom it was made. But when we look for *practical remedies*, we look in *vain*; and it

vexation and interruption in the working of the Mines. Such interference is contrary to every sound principle ; and we have sufficient evidence to prove that the arbitrary interference exercised by the Continental Governments has been in the highest degree detrimental. It is self evident that the *workings* of a Pit, which must be controlled and varied by the different changes that take place in the natural formations of the Mines, such as the slips, faults, rises and falls, constantly occurring in the Thick Coal ; it is evident that these, and many others, cannot be brought under any *compulsory* code of *Regulations*. I do not contend that if a safe *system* of ventilation can be pointed out, that it should *not* be enforced ; it *ought* to be ; and it *will* be, if it is once proved that it *can* be, and this will be done by the humanity and the good sense of the Proprietors, the Mine Surveyors, and the Charter Masters ; and if neglected by them, it will be *compelled* by the voice of the Public and the Workmen. These means will be found infinitely more effectual and far less objectionable than any interference of the Government.

always *must* be so ; for the proper remedies are so various, that they can only be *selected* according to the *particular nature* of *each* case by Men whose long and daily experience enables them to chuse *that* remedy which is *most* proper for the evil presenting itself at that moment. We may as well expect an *universal* Medicine for *all* disorders, as an *universal rule* for *all* the variations we meet with in the Mines. It is of little use to tell us that a "torpedo" attached to the bottom of a line of Battle Ship *will* infallibly destroy it ; we must have some one to tell us *how* it is to be fixed there ; and also some one to fix it.

I have found the system I have recommended to give a perfect and absolute *command* over the ventilation of *every part* of the Thick Coal Mines ; and others will do the same if they will carry it through with a strict attention to the *principles* I have laid down. Observe the following conditions and serious explosions will *not* occur :—

1st, That the Air head shall always open into the *highest* (practicable) part of the Mines which are being gotten. 2ndly, That the Air head shall be in continuous communication from the Workings to the Air Chimney of sufficient dimensions. 3rdly, That the Air head shall not, in any part of its course, be *depressed*¹² below the level of its opening into the Workings. 4thly, That the Air Chimney however formed (whether by a separate shaft or in the manner I recommend) shall never be used for *any other* purpose than the passage of the current of Air from the Workings to the surface. 5thly, That the top of the Air Chimney shall be always closed from the external Air, and shall be connected with a Ventilating Chimney of sufficient power. When I can be shewn a Thick Coal Pit at work, in which it can

12. It is by no means an unusual *practice* to *depress* the Air head in parts, and then raise it again to its former level ; under the erroneous idea that it will, (like water) as they term it, " Find its level," but it will *not* ; the Gas will not *descend*, and a serious interruption to the proper Ventilation of the Mines is interposed. I have before said that such changes *may* be *occasionally* necessary, but they should be continued no longer than *absolutely necessary*, and the level should be re-established as soon as possible.

be proved to me that all these conditions are complied with, and in action, I shall, without hesitation, pronounce the Ventilation of that Pit to be in every respect secure. But this and all other Systems must fail without the care and vigilance of a well skilled Mine Surveyor.

I have adopted this principle of ventilating Pits by Air Chimneys for Twenty-five years; in fact, all the Pits sunk by *myself* at Corbyns Hall, for Coal Pits, when the Colliery was first established, have such Chimneys;¹³ and the Thick Coal, to a certain extent, was worked by them; and the thinner Mines of Coal and Ironstone almost wholly so. But they were considered as innovations; and as the Dog returns to his vomit, so the prejudices of all employed brought them back to their old practice at the earliest opportunity. The want of an intelligent Mine Surveyor (and I could find none such,) and my own occasional absence, caused it to be disused

13. The original Chimneys were less in dimensions than those I now make: only twenty inches by fourteen inches, about half the area I wished them to be. But they were as large as I could get them made at that time. The Sinkers could not "cut them," so they said; the Shaft would "fall in," the Ground Bailiff protested. All persuasions were useless; and these and many other absurdities, they maintained as stoutly as the Irish did when they insisted upon *their* postulate "That Nature had given tails to their Horses to enable them to draw the plough." Compulsion was the only means likely to be of use in either case, and it was not then convenient to me to employ it. But such small Air Chimneys proving so far effectual, was an assurance of the success of the *principle*.

from time to time, and it was only partially exercised. It is only within these two years that I have been able to carry it through an extensive Pit *systematically*; and to effect this I was compelled to take the superintendence into my own¹⁴ hands. The case is now altered, I have a Mine Surveyor¹⁵ who thoroughly understands the *System* and energetically adopts it, and with the most complete success.¹⁶

At King Swinford I have two Pits, *each* finding *their own Air*.¹⁷ I sometimes work the Thick Coal

14. I have the satisfaction *now* to say, that my Charter Masters and Workmen *are* from prejudiced opponents become the warmest supporters of my Plan; and men who have left the Pit eagerly return, finding, as they say, "the Air so different" in other Pits.

15. In every mineral Field raising *all* the materials required for the consumption of Furnaces making Four Hundred Tons per week, such a man will find plenty of employment. My intelligent and indefatigable Surveyor, "Moses Taylor," finds ample occupation for twelve Hours every Day, with the assistance of an Under Bailiff.

16. During the late hot Summer, whilst many of the Pits in the Neighbourhood were unable to work on particular days for *want* of Air, I never experienced any inconvenience in mine.

17. Before we can avoid accidents we *must* have a more perfect system; it has been lately freely asserted that our disasters may be attributed to the want of CARE in the Workmen employed. I do *not* coincide in this opinion. It would be a strange anomaly to find HABITUAL want of CARE amongst men (I speak of them as a BODY) who well know (after a month's experience in a Thick Coal Pit) that they must owe their lives to their *own care*. It would not be easy to present a stronger motive of Caution to a man than *this*. The employment of Colliers and Sailors much resemble each other. They have both dangers of great *variety* to cope with, and such as can only be warded off by a quick Eye and Ear; by a presence of mind never slumbering, and an instinctive perception of the means best suited to the immediate emergency. To these must be added a strong hand and resolute heart; and all of them must be instructed and guided by long experience. In the midst of dangers *reckless* individuals no doubt may be found; but it is not

in one Pit ; and in the other Pit the White Ironstone lying beneath it; and sometimes the Thick Coal in *both*. Very little preparation or expence is necessary to enable me to do one or the other, as my Air Chimney reaches to the bottom of the Pit, and furnishes Air for either purpose at pleasure. The Thick Coal *abounded* in Gas, but it is now so *drained* that all difficulties have disappeared ; and my men would treat the Safety Lamp “ like unsoured Armour hung by the wall,” if I permitted it. The use of it is indeed a “ form ” rather than an “ essence,” but I never suffer it to be neglected, as it tends to establish habits of care and circumspection in other cases.

A great improvement has resulted to the *health* and *comfort* of the Workmen employed. The Air in my King Swinford Pits is Ten degrees (Fahrenheit) cooler than any Pits I have tried worked in the present mode, owing to the copious supply of *fresh* air. They are frequently tried, and found 62 to 64 degrees in the Workings ; whilst at the *same* time the Air in the *Workings* in Pits aired in the usual way is found from 74 to 78 degrees. The

a *character* that can belong to such a *body* of Men. An identity of danger has produced in both Classes many qualities which distinguish them from other classes. The Collier is as strongly marked by his peculiar habits, and also by his superstitions as the Sailor. Their World is comprised in our PITS and our *Ships*. But their peculiarities are harmless, and we do not possess two classes of men more valuable or meritorious than our Sailors and our Thick Coal Colliers.

former, the temperature of a comfortable Sitting Room, and the latter that of a heated Cotton Mill. The number of men employed in a Thick Coal Pit varies considerably, in case of more or less Gate roading being wanted ; but it has in many instances happened, that men have sought the first opportunity that might be open for them to return, after leaving the Pit, in consequence of the greater degree of comfort they enjoy by a more plentiful supply of Air. I must still say a few words upon the necessity of having *a system* of careful and *skilful* superintendence provided by the Proprietors ; for without it no radical amendment can ever be effected.

I consider no man properly qualified as Ground Bailiff, or Under-ground Mine Surveyor, unless he can take *accurate levels* ; unless he can draw clear and correct plans of every description, both vertical and horizontal, as regards the Sinking, Heading, Gate and Air roading, Levels and Workings, that he purposes to execute before his Shafts are *commenced* ; and also can correctly check the execution of all these works by *reference* to the plans *previously* drawn. He should also have a general knowledge of the laws and properties of the two elements of Air and Water which he has constantly to deal with ; and a competent acquaintance with Arithmetic is also necessary. He *ought* to possess some knowledge of Mechanics and Mathematics. A man of this de-

scription will find plenty of exercise for all these qualifications ; and ample employment for his time in superintending the various duties of a mineral field, capable of supplying a set of works producing Four Hundred tons of Iron weekly,—that is to say, provided he *executes* his duties *properly* and *efficiently*.

The Proprietors of Mineral Fields, with the help of full and correct plans, would soon be able to frustrate any attempt either to commence a wrong *system* of ventilating and working the Mines, or to detect any infringement of that which was right, by insisting upon correct reports, and comparing those *with their Plans*. It is not to be expected that the nerves, or the time of all Proprietors, will allow them to descend their Pits and see the under ground operations with their own eyes. I cannot but consider it as a matter of reproach to us, that having a district of greater Mineral wealth than that of any equal area in the world, that we should be destitute of a *Mining College* or *any educational Establishment*, capable of affording that Instruction which is so urgently required. I earnestly hope that some of the many intellectual members that we have among the higher ranks of the trade (and who are younger than myself) may be induced to direct their immediate and active attention to this crying deficiency ; and efface this stain from our escutcheons.

If these few observations should have the effect of quickening such a movement, I shall think myself richly rewarded by this alone, for the trifling trouble this little Book has given me. I have endeavoured to be as brief as possible, and my object has been to write, as far as the subject admits, in such language as will be best understood by *all*. Let me add, that my mode of Ventilation may be applied to the *thinner* measures of Coal or Ironstone with the utmost ease. If it is effectual as regards the Thick Coal, it *must* be *superfluously* so as regards the former. The greater comprehends the less, and to enter into fresh details with reference to the thinner Veins would be mere idle repetition; or rather it would be like the proceeding of the worthy Gentleman, who, having provided a Hole for the Cat, deemed a second necessary for the Kitten.

A very great saving of expence will be found to accompany the *system* I have pointed out; not only in working the Thick Coal, but subsequently in getting the thinner Veins of Coal and Ironstone. A very considerable amount of outlay, as well as (frequently) a great loss of time, is incurred in obtaining the necessary supplies of Air for working the *successive* strata of Mine. The Air Chimney is accessible at any point in the Shaft, and the Shaft is *always* kept well aired, which is of importance, as it is often found convenient to suspend the workings of the Pit

for a considerable time after the exhaustion of one of the strata, and before it may be desirable to commence the working of another. I have found my Pits even with the small Air Chimney in a perfectly well aired state, and quite safe to descend, and commence new operations at a day's notice, after the suspension of the workings for several years. A very considerable saving will be found to result from this circumstance, before the *whole* of the strata are worked out.

The object of my Book is not to enter into the *details* of the best *mode* of *getting* the Mines; but to point out a *combination* of practical means, by which a safe (or at least a safer) *system* of *ventilation* may be established. The general sympathy shewn, and the munificent charity displayed, on the occasion of the late frightful explosion at Oldbury, gives me the fullest assurance, that I shall find not a few valuable supporters in the attempt to save in future the numerous valuable lives of which we have had to deplore the loss year after year. I had hoped at some of the late meetings which have taken place, to have seen that some one would have explained the *causes* of these fatal events, and suggested *some* probable means of *prevention*. If any such exposition has been made it has escaped my notice. I have therefore (most unwillingly, personally speaking) felt myself called upon to point out the practi-

cal means which experience has disclosed to me as best calculated to abbreviate (at least) the frightful list which humanity recoils from. I also felt that it was discreditable to a trade (containing in its ranks so many intelligent men) to realize before the world the fable of "The Carter and Hercules," and like the Carter call aloud for that assistance from Government which *must* at last *emanate* from *themselves*.

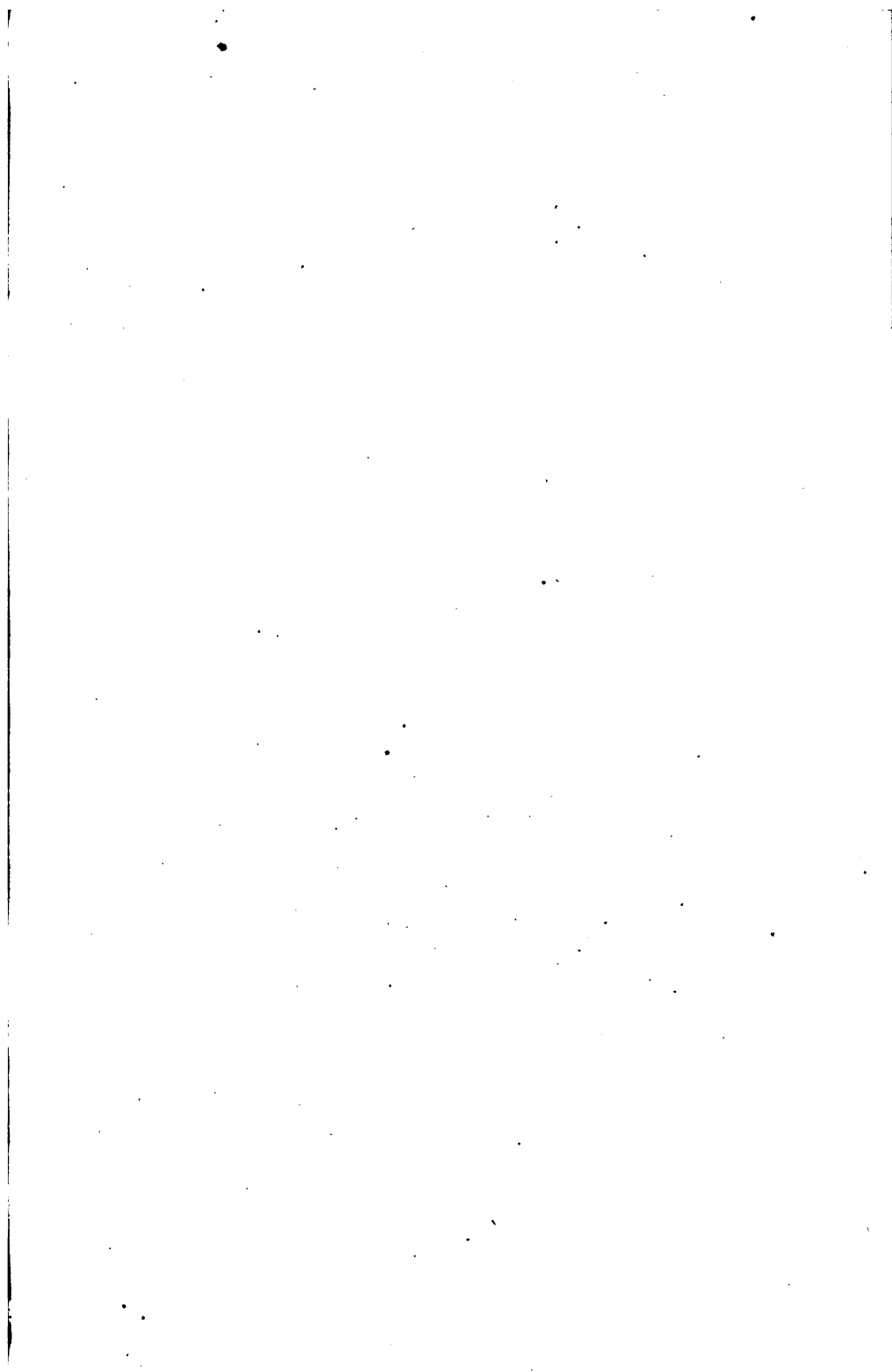
Before I conclude, I cannot deny myself the gratification of a passing allusion to my Brother's Treatise, "*Practical Remarks on the Construction of the Staffordshire Blast Furnace*;" it may be called the Parent of my own; for if he had never written, the idea of making the knowledge that I had acquired of use to others in a similar way, would not, I think, have occurred to me; I should, I believe, have been content with the light that was sufficient for my own footsteps, and have left it to shine or not for the guidance of others as chance might determine. But when I saw what he had done, I could not help reflecting that the time might come that I might store up something of similar, though not of equal value; that I too might fulfil, to some extent, what ought to be a great object of our being. "To do our duty in that state of life to which it has pleased God to call us," is *that* object; and it is but poorly performed if the "Be all and end all" of our existence is to be no where found but on the grave that

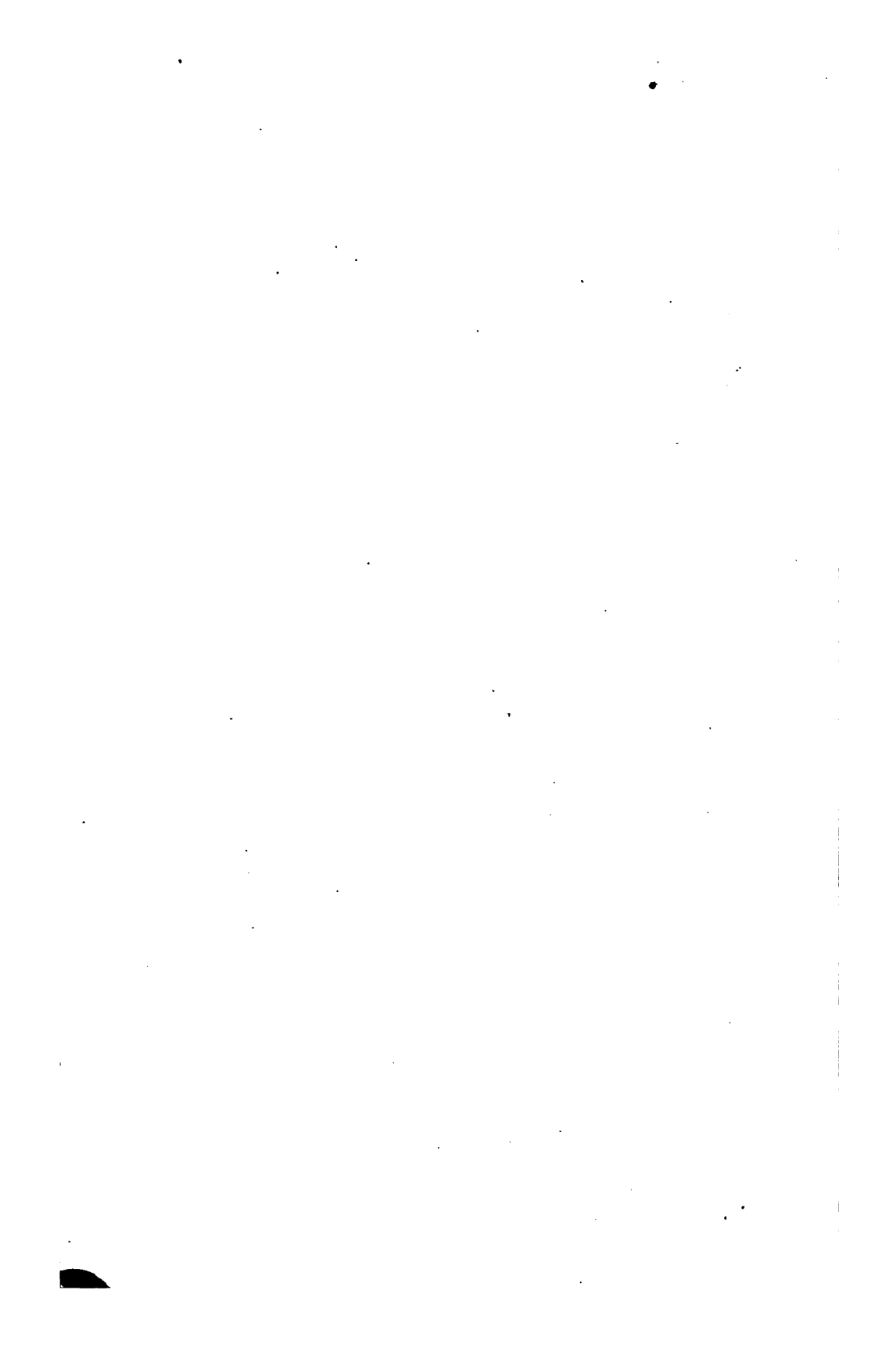
covers us. By a wise arrangement of my Brother, the principle of the division of labour was introduced into our concerns, and strictly carried out. With the Iron Works I never interfered, nor he with the Colliery, and thus it was that each had a separate object upon which each might concentrate his thoughts; in my Brother's case the result has been *indeed* important; for few will deny that he has taught the Staffordshire Ironmaster how to *economize his fuel* and *double his make*. As an Improver and Inventor he has placed himself in the highest rank; but as yet his fame is far below his merit. Whatever has been acquired too easily it is the habit of man to undervalue; we think but little of what has cost but little: "Too light winning, makes the prize light." The very simplicity of the plan too, (a rare excellence!) the transparent clearness of his instructions, the disregard of self that threw open so freely to others what might still have remained in his own exclusive possession, and the utter absence of parade and pretension with which he did it, all have conspired to blind the unthinking, not only to the surpassing value of the gift, but to the rare combination of mental powers that enabled him to make it. Time will however do him justice; and he will take his stand hereafter on the same platform with our greatest benefactors—with DUDLEY, who taught us the use of Pit Coal, and CORT,

the inventor of Puddling. In one respect he has been more fortunate than they; if he has sown he has reaped, and *his* sole reward has not been ruin. In ancient Rome such men as these would have been honoured with the Civic Crown; but we live under a different dispensation: ours is an Age of Gold, if not a Golden Age; and Mammon has decreed that Pelf is better than praise; and a good hard money making Patent the best of distinctions. If it had been a stranger, or a dweller in a foreign land, to whom I am indebted, in common with so many others, for the discovery that has doubled my profits, (for it amounts to this, and more) I should have felt it my duty to offer him this passing homage; and am I to withhold it because he is my Brother? It would be the falsest of delicacies; but were it otherwise, I could not be silent. On an occasion like this a thousand feelings would compel me to speak of him, and should this Book have more than a fugitive existence, its dearest reward to me will be, that it has given me an opportunity of associating our names together; of recording in terms, however inadequate, the pride, the pleasure, and the strength, that I have derived from our uninterrupted and cordial connection. Side by side we have stood together in Sunshine and in Storm; hand in hand we have struggled through years of bitterness and hardship; to *him*, alas! made doubly bitter by

broken spirits and ruined health ; but in spite of these he took the foremost place, and shrunk not till the victory was won—*his* victory. Though absent from me now, and comparatively powerless, I still regard him as my better Genius, and it is my fondest hope, and consoling faith, that Death itself shall not divide us.

FINIS.





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